THE

JOURNAL OF ECONOMIC BIOLOGY.

RATS AND THEIR ANIMAL PARASITES.[1]

By

A. E. SHIPLEY, M.A., Hon. D.Sc. (Princeton), F.R.S.,

Fellow and Tutor of Christ's College, Cambridge, and Reader in Zoology in the University.

THE overwhelming majority of rats fall under two species (i), *Mus rattus*, the black rat, and (ii) *Mus decumanus*, the brown rat. The original home of both species is, according to Dr. Blandford, Mongolia, but the date of their first appearance in our islands is a matter of some uncertainty. According to Helm *M. Rattus* passed into Europe at the time of the *Völkerwanderung*, and doubtless accompanied the migrating Asiatic hordes on their journeys westward. The name rat appears in early High Dutch glossaries; it is mentioned by Albertus Magnus, and occurs in early Anglo-Saxon writings in England. This evidence is, however, not conclusive that in those times the rat had entered Great Britain; indeed, according to Bell,[2] the black rat was not known here until before the middle of the sixteenth century, at least, he says, no author more ancient than that period has described, or even alluded to it as being in Great Britain, Gesner being the first to do so. Jenyns, in his Manual of British Vertebrate Animals,[3] describes *M. rattus* as "truly indigenous," but this is in comparison with the brown rat, whose comparatively recently arrival he chronicles. It is said to have been common on the continent of Europe in the thirteenth century.

Mus rattus has, as a rule, greyish-black fur above, ash-coloured below, with a tail a little longer than the body and head. It is smaller and more elegantly built than the brown rat, its snout is longer and more slender, and the long, thin, scaly tail is about 8 or 9 inches in length. The British forms average in length 7 inches from the tip of

[1] Read before the Association of Economic Biologists, Edinburgh Meeting, July 28th, 1908.

[2] A History of British Quadrupeds. 2nd Ed. London, 1874.

[3] London, 1833.

the nose to the origin of the tail. Although known as the black rat, its bluish, or greyish-black colour is, both in the East and in Northern America, frequently replaced by brown on the upper surface, and by white fur in the lower, or by a yellowish brown rufous colour. The ears, feet, and tail are black. When kept as pets—and they frequently are—white and pie-balded varieties are often bred. The ears are larger in proportion than *M. decumanus*, the rings of scales on the tail better marked, and spines in the fur are not uncommon.

The black rat, or Old English rat, begins to breed under the age of one year, and goes with young six weeks; it breeds frequently during the year, but does not commence in Bombay, according to the Plague Commission, until it has attained the weight of at least 70 grammes. In India they breed all the year round. In Britain they produce six to eleven young at a time; in India the average is 5.2; the largest number found by the Plague Commission having been 9. In Bombay it is noteworthy that in both species the percentage of young rats to the total rat population is greater during the warmer months—from June to October—than at other times of the year. It is also noteworthy that the fall in fertility begins before the onset of the plague Epizootic, though later it roughly coincides with it. In Britain they increase so fast as to overstock their abode, and thus they are forced, from deficiency of food, to devour one another, and this alone, Pennant thinks, "prevents even the human race from becoming a prey to them, not but there are instances of their gnawing the extremities of infants in their sleep."

The black rat is catholic as to its diet, omnivorous, and it devours every kind of human food. It is more domesticated than its congener, more devoted to human habitation, and it does immense damage to stored grain, seeds, and cereals. It is a better climber than *M. decumanus*, which accounts for its being *par excellence* the ship rat, since it can climb hawsers and more readily come on board. It makes its way up to the higher rooms of the tenement houses in Indian cities, where it nests and breeds undisturbed by the human inhabitants. Pennant[1] draws attention to the harm the black rat causes by gnawing and devouring not only edibles, but paper, cloth, water pipes, and even furniture. In England it makes a lodge, either for the day's residence, or a nest for its young, near a chimney, and "improves the warmth by forming in it a magazine of wool, bits of cloth, hay or straw." In the East it nests in the indescribable rubbish and "unconsidered trifles" the natives accumulate in their rooms, and is seldom, if ever, interfered with.

[1] British Zoology, London, 1812.

Its climbing habits enable it to ascend trees, and in India it frequently nests among the branches. In some tropical islands *M. rattus* lives exclusively in the crowns of cocoa-nut palms, feeding almost entirely on their fruit.

Contrary to the opinion of Blandford, Oldfield Thomas thinks that the black rat originally came from India, and thence spread all over the world, exterminating the indigenous rats of other countries, only to be exterminated later by the arrival of the stronger *M. decumanus*. At the present time the last-named species is not yet established in some countries, for instance, in South America. On that continent, *M. alexandrinus*, a tropical variety of *M. rattus*, is waging war on the less highly organized native rice-rats or Sigmodontes. *M. alexandrinus* has a gray, or rufous back, and a white belly.

M. rattus has a milder, more amenable, and tameable character than *M. decumanus*, and the white, or pied varieties, so dear to school boys, are of this species. It is cleanly in its habits, and the skin is kept in excellent order. Like other rats, it holds its food in its hands whilst eating, and it drinks by lapping.

Although the black rat is tending to be driven out by the brown rat, it still lingers on in some warehouses in London, at Yarmouth, in Sutherlandshire, I believe in Lundy Island, and I have been told it occurred not so very long ago on the island in the Serpentine. It doubtless occurs in many other places.

Mus decumanus, the so-called brown rat, undoubtedly comes from Central Asia, and at the present time there is a rat in China described under the name, *M. humiliatus*, which is so indistinguishable from the brown rat that is thought to be the parent form.

The migration westward of the brown rat certainly took place much later than that of the *M. rattus*. Its first appearance is difficult to date. Undoubtedly large hordes of them crossed the Volga in the year 1727, and continued their journey towards Central Europe. The following year, brown rats, according to Pennant, appeared in England—Jenyns says not till 1730—and it almost certainly came in ships, for on its journey overland it only reached Paris about the year 1750. Reaching England about the year of the second George's accession, and but thirteen years after the first of the House of Hanover succeeded to the throne, it was called, probably by the adherents of the Stuart cause, the Hanoverian rat. It was also called the Norwegian rat, possibly from the mistaken idea that it reached these islands from that country. It has now passed to the Northern half of the New World, where it is gradually driving out many of its weaker brethren. Its numbers are, however, kept within certain limits by

wolves, lynxes, racoon, coyotes, opossums, and other carnivora, and especially by the skunks which enter barns and outhouses in search of them.

Until the discovery of America, the rat and mouse were unknown in the New World, and the first rats who ever saw it are said to have been introduced in a ship from Antwerp.[1]

The brown rat is of a grayish-brown colour, tinged with yellow and white beneath. The tail is not so long as the body. It is a larger rat than *M. rattus*, has shorter ears, a more powerful skull, and 10 to 12 mammae. Its ears, feet, and tail are flesh-coloured. Like *M. rattus*, colour varieties occur often, the melanistic, not uncommon in Ireland, being sometimes mistaken for the black rat. It is a larger animal than its congener, more heavily built, with a more powerful head, and blunt jaw. The head and body measure some 8 to 9 inches, but the tail, as a rule, does not surpass the length of the body alone. Its weight averages about nine ounces. It is extremely fierce, and extremely cunning, and in the struggle for existence with allied species, has hitherto been consistently successful in its fight.

Mus decumanus is very prolific, and produce several litters a year, each averaging 8-10 in number, but 12 or even 14 young are not very uncommonly born at one time. It begins breeding young, a half-grown female producing a litter of three or four, but in Bombay the sexes do not breed until they have attained at least a weight of 100 grammes. The young are naked, *i.e.*, without hairs, and of a beautiful pink colour. They are blind, and their ears are gummed down over the auditory meatus. They are very weak and helpless, and need that maternal care, which, to do the female rat justice, is never withheld.

M. decumanus is less attached to the dwellings of man than *M. rattus*, still it does live in houses, though owing to a lack of climbing power, it is never found above the third floor. It is largely a burrowing animal, and makes its nests in its burrows. *M. rattus* can also burrow, but not so readily, and it nests not in the burrow, but in some obscure corner. The brown rat frequents barns, granaries, stables, slaughter-houses, rivers, ponds, ditches, drains, gullies, and sewers; it is, in fact, sometimes called the sewer rat. It is less particular in its food than the black rat, which are more usually found in grain stores. Although in Bombay the relative numbers of *M. rattus* caught to *M. decumanus* was as seven is to three, in open spaces, gardens, etc., the latter was much the commoner. Yet the report of the Plague Commission states that the authors "do not think it an exaggeration to state

[1] Ovalle's History of Chili, in Churchill's Voyages. III, 45.

that every inhabited building in Bombay City and Island, not excepting even the better class bungalows, shelters its colony of *M. rattus*."

Both species readily take to water, though *M. rattus*, being the better climber, more readily gets on shipboard. They will swim rivers and arms of the sea. The rats which infest the London Zoological Gardens are said to nightly swim the canal in Regent's Park. Rats constantly make their way to coastal islands, and in a comparative short time clear the place of indigenous rabbits and birds. Puffin Island, off the coast of Anglesey, and the Copeland Islands, in Belfast Bay, are two examples of islands at one time leased for the sake of their rabbits to people who had to give up the lease after the rats had landed on them. Similar cases are known off Denmark. They eat greedily birds' eggs, and are said to convey them over considerable distances, though how they do this is not very clear. After the destruction of the vertebrate land-fauna, they fall back upon the dwellers in the littoral, and live on prawns, shrimps and molluscs. They are very fond of fish, and Lyddeker, in the Royal Natural History, states that they occasionally catch and eat young eels. As their parasites show, they eat insects such as the meal-beetle, and when in the field they eat land-snails, insect larvae, and other food, which conveys into their bodies the same tape-worms, etc., which we find in the hedgehog and in the smaller carnivora.

They are, in fact, omnivorous, and nothing in the way of human food is alien to them. They do enormous harm to corn ricks and to stored grain. They are inveterate enemies to the hen roost, the pigeon house and, as we have seen, to the rabbit warren. When pressed by hunger they readily turn cannibal, and the brown rat easily masters the black. There are stories of some few specimens of each species being left in a cage overnight; on the following morning there were only brown rats. To some extent they help to keep down the field mice (Genus *Microtus*), and this is especially the case in North America,[1] but the benefit is doubtful since they are held to be at least as destructive to the crops as the field mice, and probably more so.

The ferocity with which they defend themselves when attacked is well known, and at times, when they are driven by hunger, do not hesitate to attack man. They are said to nibble the extremities of infants, and on one—apparently authentic—instance they overcame and devoured a man who had entered a disused coal mine tenanted by starving rats. The bite is said to be severe (they will bite through a man's thumb nail into the flesh) and to be long in healing.

[1] An economic study of Field Mice (genus *Microtus*). Dr. Lantz, U.S. Dept. of Agric., Biol. Survey. Bull. 31.

Rats eat much garbage and offal, and readily feed upon dead bodies. About sixty years ago there stood at Monfaucon, a slaughter-house for horses, and this it was proposed to remove still further from Paris. It is stated that the carcases of the horses slaughtered, which sometimes amounted to thirty-five a day, were cleared to the bone by rats in the course of the following night. This excited the attention of a Mons. Dusaussois, who made the following experiment: He placed the carcases of two or three horses in an enclosure, which permitted the entrance of rats by certain known and closable paths. Towards midnight he and some workmen entered the enclosure, closed the rat-holes, and in the course of that night killed 2,650 rats. He repeated the experiment, and by the end of four days had killed 9,101 rats, and by the end of a month 16,050 rats. During the process of these experiments other carcases were exposed in the neighbourhood, so that in all probability Mons. Dusaussois attracted to his enclosure but a small proportion of the total available number of rats. All around this slaughter-house the country was riddled with extensive burrows, so that the earth was constantly falling in. In one place the rodents had formed a pathway 500 yards long leading to a distant burrow.

A rat census can never be taken, but estimating that there is one rat for every human being on these islands, or less than one rat for every acre of ground, a moderate estimate would give us 40,000,000 rats at any one time. It has been calculated that a rat does at least 7s. 6d. worth of damage during the course of the year, hence in Great Britain and Ireland we may annually charge them with a loss of at least £10,000,000.

From what has been said it is obvious that rats cause enormous damage to humanity, which is counterbalanced by the almost infinitesimal good they do as scavengers. I do not propose to consider in detail the harm they do as disease carriers, but I would remind you that the rat is the primary host of *Trichinella spiralis*, Owen, which, when conveyed from the rat to the pig, and—by eating uncooked or imperfectly cooked pork—from the pig to man causes severe and very fatal epidemics, and enforces the expenditure of large annual sums on meat inspection. They also convey a virulent form of equine influenza from one stable to another, and the "foot and mouth" disease. But what is infinitely more important than all the other injuries of all kind put together is the harm they bring to suffering humanity by conveying the bubonic plague from one patient to another. The plague under which India and great parts of Burmah is "groaning and travailing," is caused by a specific bacillus discovered in 1894 by Yersin at Hong Kong. It flourishes in other vertebrates besides man and the rat, but

owing to the migratory habits of the latter, the rat is the most effective agent in the spread of the disease. Both species of rat seem about equally susceptible, and the presence of the microbe showed no special relation to either the age or the sex of either species. The microbe is conveyed from rat to man by a flea. (v. p. 70).

The destruction of the rat is now being urged on all hands, and in the near future we shall probably see a considerable diminution in their numbers in the more civilized countries of the world. This will mean a considerable upset in the balance of power of the almost hidden fauna which surround us on all hands. It may even, as the Medical Officer of Health for Bristol has pointed out, lead to an increase of immigration of ship rats, those most likely to be infected by plague, to take up the places vacated on land by the slain. By one of those commercial agencies—I don't propose to go into the merits of any one of them—which the enterprise of our merchants is now pressing on the public, a large landed proprietor a few months ago completely freed his buildings of rats and mice. A few weeks later his house and outbuildings were overrun by swarms of what to him—for in the time of the rats and mice he had never seen one—was a new and formidable insect. He sought the aid of the Royal Agricultural Society, who referred the matter to their scientific adviser, who pronounced the insects to be cockroaches!

In the eighteenth century, among the officers of his "British Majesty," was an official rat-catcher, whose special uniform was scarlet, embroidered in yellow worsted, with figures of field mice destroying wheat sheaves. Enquiry at the Lord Chamberlain's office has satisfied me that the officer still exists and still catches rats, but I fear the uniform has been abolished. However, a book has recently appeared dealing officially and exhaustively with all matters of this kind, and as soon as I can come by it I will look the matter up. Should this dignified uniform have really disappeared, might not a humble petition be presented that it be revived? Surely never more than at the present time should the honour and glory of the rat-catcher be exalted.

ECTOPARASITES OF THE RAT.

INSECTA.

A. SIPHONAPTERA (FLEAS).[1]

1.—Ceratophyllus fasciatus, Bosc.

This is the flea most commonly found on *Mus rattus* and on *M. decumanus* in Great Britain and indeed throughout Central and Northern Europe. It also occurs on the house-mouse *M. musculus*. Rats from Cape Town also harbour this species, and it is occasionally found on rats from India.

2.—Ceratophyllus londiniensis, Rothschild.

Synonym. *Ceratophyllus italicus*, Tiraboschi.

Very common on both species of rats and allied forms. Apparently this species does not bite man.

3.—Ceratophyllus consimillis, Wagner.

4.—Ceratophyllus lagomys, Wagner.

5.—Ceratophyllus mustelae, Wagner.

6.—Ceratophyllus penicilliger, Grube.

Numbers 3, 4, 5 and 6 are all very common fleas on *Mus decumanus*, though Tiraboschi has not found them in Italy. Systematically they are allied to *Ceratophyllus faciatus*, Bosc.

7.—Ctenocephalus canis, Curtis.

Occurs chiefly on the dog, but has been found on many Carnivores, on hares and rabbits, monkeys and man, and the rat. In Italy some 25-30 per cent. of rat-fleas belong to this species. The members of it are unusually agile and are great jumpers.

8.—Ctenocephalus felis, Bouché.

Found on cats and also on rats; like the preceding species, it is found widely distributed in the Old World. Mr. Rothschild tells me there is no doubt that these two species are distinct.

---

[1] Rothschild, N. C. Jour., *Hygiene* vi, 1906, p. 483.

9.—**Ctenopsylla musculi,** Duges.

Is the commonest flea found on the domestic mouse in our country, and it sometimes makes its way to the rat; it has been taken from *M. rattus* in Pretoria, and in Italy is the commonest flea on that species. It seems to be cosmopolitan in its distribution.

10.—**Dermatophilus caecata,** Enderlein.

The genus *Dermatophilus* (Guerin) Rothschild, with the genera *Echidnophaga* and *Hectopsylla*, comprise the family SARCOPSYLLIDAE, which includes the Jiggers or Chigos, whose females burrow in the skin. *D. caecata* is recorded from *Mus rattus* taken in San Paulo in Brazil.

11.—**Echidnophaga, rhynchopsylla,** Tiraboschi.

Synonym. *Echidnophaga murina*, Rothschild.[1]

This flea, which Dr. Tiraboschi found on *Mus rattus* in Italy, usually upon the heads and snout, is interesting because it, with *E. gallinacea*, are the only two species of the family SARCOPSYLLIDAE so far recorded in Europe. It is nearly allied with *E. gallinacea*. The females all had their heads solidly embedded in the skin of the host.

12.—**Echidnophaga gallinacea,** Westwood.

Synonym. *Echidnophaga gallinacea*, Tiraboschi.
Argopsylla gallinacea, Baker.
Echidnophaga gallinacea, Rothschild.

Tiraboschi has taken this, which he considers a species distinct from *E. rhynchopsylla* from *Mus rattus* in Italy.

13.—**Neopsylla bidentatiformis,** Wagner.

Taken on *Mus decumanus* in the Crimea and on *Spermophilus* sp. in Siberia and the Caucasus.

14.—**Loemopsylla cheopis,** Roths., 1903.[2]

Synonym. *Pulex murinus*, Tiraboschi.
Pulex pallidus, Tidswell.
Pulex philippinensis, Herzog.
Pulex brasiliensis, Baker.

This flea was described by Rothschild from specimens taken from numerous small rodents in Egypt. Tiraboschi found it commonly in

[1] Rothschild, N. C., Rep. Thompson Yates and Johnston Lab., Liverpool, vii (new ser.), 1906, p. 55.

[2] Jordan, K. and Rothschild, N. C., Parasitology, 1908, vol. i, p. 42.

Italy, and on 40% of the ship rats in Genoa. It occurs on from 80% to 90% of the rat population of Sydney and Brisbane, where it was described by Tidswell[1] under the name of *Pulex pallidus*, and on 25 per cent. of the rats in Marseilles, where Gauthier and Raybaud[2] record that the numbers decrease as the distance from the water-front increases. Herzog[3] took 42 fleas of this species from 153 rats of both species in Manila, and it also occurs commonly in South America. It has been found at Plymouth and at Pretoria. It is by far the commonest of the rat fleas of warmer countries, and the Plague Commission consider that it forms 99 per cent. of the fleas found on *Mus rattus* and *M. decumanus* in India.

This species readily passes on to monkeys, guinea-pigs, and man, and we have seen it lives on many wild rodents. It is now recognized as the chief means by which the plague is conveyed from rats to man.

15.—**Pulex irritans**, Linn.

This, the common human flea, has been found biting both *Mus rattus* and *M. decumanus*, as well as many other animals which come in contact with man.

According to this list the following species occur on *Mus decumanus*, but not on *Mus rattus*:—*Ceratophyllus consimilis*, *C. lagomys*, *C. mustelae*, *C. penicilliger* and *Neopsylla bidentatiformis*; whilst *Dermatophilus caecata*, *Echidnophaga rhynchopsylla* and *E. gallinacea* occur on *Mus rattus* and not on *Mus decumanus*. Further investigations will very likely reduce these two lists.

B. ANOPLEURA—LICE.

Enderlein[4] has recently separated out from the genus *Haematopinus* certain forms which he places in two new genera *Hoplopleura* and *Polyplax*.

16.—**Hoplopleura acanthopus** (Drury).

Synonym. *Haematopinus acanthopus*, Drury.

This is figured and described by Tiraboschi[5]; it occurs on *Mus decumanus*, on the mouse, and on several species of wild Muridae.

[1] Tidswell, F., Report on the Second Outbreak of Plague at Sydney, 1902, by Ashburton Thompson.

[2] Gauthier and Raybaud, Rev. d'Hygiène xxv, 426.

[3] Herzog, M. Zeitschr. Hygiene, li, p. 268.

[4] Zool. Anz., xxviii 1904-5, pp. 121, 220, 626, and xxix, 1905-6, p. 192.

[5] Arch. parasit. viii, 1903-4, p. 318.

17.—**Polyplax spinulosus** Burm.

Synonym. *Haematopinus spinulosus*, Burm.

This louse has been found by many observers on *Mus decumanus*, and has been recently figured and described by Tiraboschi.[1] It is believed to act as the intermediate host of *Trypanosoma lewisi*.

18.—**Pediculus capitis**, Nitzsch.

This species is thought occasionally to infest the rat. They are known to suck the blood of rats when placed on them, and they are capable of transferring the plague to man. It is thought that this may be not unfrequent amongst the sect known as Janis, to whom all life is sacred, and who are consequently exceptionally verminous.

ARACHNIDA.

ACARINA.

DEMODICIDAE.

19.—**Demodex muscuii**, Oudemans.[2]

It seems doubtful if this is but a variety of *Demodex folliculorum*, which lives in the sebaceous glands and hair follicles of man. It has been found in the mouse and in rats, but the species is not stated

IXODIDAE.

20.—**Ixodes ricinus**, L.

Synonyms. *Acarus ricinus*, L.
Ixodes rufus, Koch.
Ixodes sulcatus, Koch.
Ixodes sciuri, Koch.

This, one of the commonest of ticks in temperate climes, and one which occurs on a very large number of very diverse animals, has been recorded by Neumann on *Mus decumanus*.

21.—**Hyalomma aegyptium**, L.

Synonyms. *Acarus aegyptius*, L.
Ixodes aegyptius, Andouin.
Hyalomma marginatum, Koch.
Hyalomma aegyptium, Canestrini.

[1] Arch. parasit. viii, 1903-4, p. 316.
Tijdschr. Ent. 1897.

Larval specimens of this genus have been identified by Professor Nuttall, which was collected off *Mus rattus* in Nowshera, North-West Frontier Province, India. This species is commonest on cattle. It also occurs on man, and gives rise to serious fevers.

22.—**Rhipicephalus sanguineus,** Latr.

Synonyms. *Ixodes sanguineus*, Latr.
Ixodes dugesi, Gerv.
Rhipicephalus sanguineus, Koch.
Rhipicephalus siculus, Koch.

Adult forms of this species occurred on the same rats as did the *Hyalomma aegyptium*, and were also identified by Professor Nuttall. It infests cattle, sheep, dogs, cats, and occasionally man. This species is common in Italy and France.

GAMASIDAE.

23.—**Laelaps agilis,** Koch.

Found on *Mus decumanus* and many other allied forms. The members of the genus *Laelaps* suck blood.

24.—**Laelaps echidninus,** Berlese.

Synonyms. *Laelaps agilis*, Koch.
Haemomyson musculi, Megnin.

Common on *Mus decumanus* and *Mus rattus* in all parts of Italy. It occurs in large numbers, 150-200 on a single rat.

25.—**Laelaps stabularis,** Koch.

Synonyms. *Gamasus stabularis*, Koch.
Gamassus complanatus, Kramer.
Gamassus fenilis, Megnin.
Hypoaspis stabularis, Canestrini.

This form, common in stables, has been found on *Mus decumanus*.

26.—**Myonyssus decumani,** Tiraboschi.[1]

A single adult female, taken on a *Mus decumanus*, captured at Rome, was described and figured by Tiraboschi. Members of this genus are true parasites, living on the blood of their host.

[1] Arch. Parasit. viii, 1903-4. p. 337.

SARCOPTIDAE.

27.—**Notoedres alepis,** Railliet and Lucet.[1]

Synonym. *Sarcoptes notoedres var muris,* Megnin, 1820.
Sarcoptes alepis, Raill. and Luc., 1893.
Notoedres muris, Can., 1894.
Notoedres notoedres, Can and Kramer, 1899.

This species lives in the ears, and on the external genital organs of *Mus decumanus* and of *Mus rattus*, and other Muridae in France, but it does not appear to do much harm. The genus *Notoedres* is allied to *Sarcoptes,* the itch-mite, and they have similar habits.

TROMBIDIDAE.

28.—**Myobia ensifera,** Poppe.

Found on a *Mus decumanus* from a house, also on white rats. It is not impossible that this and the succeeding species are identical.

29.—**Myobia musculi** Schrank.

Synonyms. *Pediculus musculi,* Schrank.
Myobia coarcta, Heyden.
Myobia musculi, Claparède.

This is commoner on the mouse, living at the base of the hairs on the head, but Megnin also records it on the *Mus decumanus.*

ENDOPARASITES OF THE RAT.

PROTOZOA.

The number of Protozoa recorded as parasitic in the rat is disappointingly small, and a renewed search would doubtless largely increase the number. In his exhaustive article on Sporozoa in Lankester's "Treatise of Zoology," Profesor Minchin mentions but one Protozoan parasite *Sarcocytis* sp. (Sichold, 1853) from the rat, though he records three from the mouse. Professor Minchin has kindly sent me the names of some more protozoan endoparasites, which are mentioned below, but I feel sure the list is by no means exhaustive.[2]

[1] C. R. Soc. Biol., 1893, p. 404.

[2] See also "Observations on the Protozoa in the Intestine of Mice," by C. M. Wenyon, Arch. Protistenk. Festb. z, R. Hertvig, Suppl. I, p. 169. Many of the Protozoa described here probably also invest the Rat.

1.—**Amoeba muris,** Grassi.[1]

The life-history of this form, which occurs in mice as well as rats, has recently been described by Wenyon.

2.—**Leucocytozoon muris,** Balfour.[2]

Balfour has described this species from *Mus decumanus*, finding it in two specimens out of a dozen examined. It occurred in the blood of the heart and of the spleen, and free forms were found as well as those living in the leucocytes.

3.—**Sarcocystis,** s.p.

This parasite was first found by Meischer in the muscles of a house mouse, and is figured and shortly described by von Siebold,[3] who found specimens, as did also Herr Bischoff, in the muscles of a rat —species not mentioned. It is possible that this incompletely described Sarcosporidian is identical with *Sarcocystes muris* (Blanchard), a very deadly parasite in mice, according to Koch.[4] A virulent poison has been extracted from a Sarcosporidian parasitic in the sheep by Laveran and Mesnil, and named by them *sarcocystin.*

4.—**Piroplasma muris,** Fantham.[6]

Fantham has made a careful study of certain phases in the life-history of this blood parasite, which he found in the blood of the *Mus rattus*, the white variety. It occurred but seldom in the peripheral circulation, and was most plentiful in the red corpuscles of the blood in the capillaries of the viscera and nervous system, especially in the liver, kidneys, and spleen. Extra-corpuscular forms occurred in groups. The complete life-history of this form has not been worked out.

5.—**Trypanosoma lewisi,** Kent.

The history of this common parasite of the rat is given in Laveran and Mesnil's "Trypanosomes et Trypanosomiases."[7] The infection seems to occur all over the world, in both *Mus decumanus* and *Mus rattus*, but the percentage of infected rats varies greatly in different

[1] Atti. Soc. Ital. Sci. Nat., xxiv, 1882, p. 181.

[2] Grassi's authority. Second Report of the Welcome Research Laboratories, Khartoum, 1906, p. 110.

[3] Zeitschr. wiss. Zool., v, 1854, p. 199.

[4] Verh. v. Int. Congr. Zool., Berlin, 1901 (1902), p. 674.

[5] CR. Soc. Biol., Paris (II) i, 1899, p. 311.

[6] Quart. J. Micr. Sci., L, 1906, p. 493.

[7] Paris, 1904.

localities, and at different times. Nuttall[1] recalls the experiments of Rabinovitch and Kempner (1899), who claim to have infected healthy rats by placing on them fleas taken from the bodies of infected specimens. The species of flea is not mentioned. Prowazek (1905) has observed the development of *Tr. lewisi* in one of the rat-lice, *Polyplax spinulosus*, and though he did not succeed in transmitting the disease from rat to rat by means of lice, he concluded that such conveyance was possible in certain cases.

METAZOA.

The following Nematodes and Cestodes entozoa have been found in the *Mus rattus*:—

A. NEMATODA.

6.—**Heterakis spumosa,** Schneider.[2]

This species is found in the caecum and large intestine of both *M. rattus* and *M. decumanus*. The male attains a length of 7 mm., the female of 9 mm.

7.—**Oxyuris obvelata,** Bremser.

Synonym. *Ascaris oxyura*, Nitzsch.[3]

This small thread worm measures in length in the male 1.6 mm., in the female 3-5 to 5-7 mm. It lives in the intestine, mostly in the large intestine. It inhabits many species of *Mus* and of *Arvicola*, also *Spermophilus citillus*, and is much commoner in the "country mouse" than in the "town mouse." As is usual the males are less abundant than the females, but are more easily found than is usual in this genus. The worms swell up, and sometimes burst by the osmotic absorption of water when placed in that fluid.

8.—**Physaloptera circularis,** von Lins.[4]

This species, which measures in the female 24 mm., and in the male 15.2 mm., was described by von Linstow from specimens taken from the stomach of a *M. rattus* collected in Madagascar by F. Sikora. Von Linstow mentions that with the exception of *Ph. muris brasiliensis*, Molin, it is the only *Physaloptera* which inhabits rodents.

---

[1] Ber. ü. d. xiv, Intern. Kongr. f. Hyg. u. Demogr, Berlin, 1907, p. 200.

[2] Schneider, A. Monog. d. Nemat. Berlin, 1866. p. 77.

[3] Ersh. u. Grub. Encyclop., vi, p. 84; Creplin, Wiegmann's Archiv., 1849, p. 56; Dujardin, Hist. Nat. d. Helminthes. Paris, 1845, p. 141; Diesing Syst. Helminth., Vienna, 1851, p. 145.

[4] Arch. Naturg., lxiii, i, 1897, p. 28.

9.—**Spiroptera brauni,** von Lins.[1]

This species was also described and figured by von Linstow, and from a *M. rattus* taken in Madagascar. The male measures 19 mm. in length, the female 54 mm.

10.—**Spiroptera ratti,** Diesing.[2]

This species is mentioned in von Linstow's Compendium, but I have been unable to find the magazine in which it is described in any of the Cambridge libraries. *S. ratti* lives in the urinary bladder.

11.—**Spiroptera sp.,** Bakody.[3]

This insufficiently described species is mentioned in a letter by Dr. Bakody of Pesth. He describes it as encapsuled in the walls of the alimentary canal, and in certain muscles of both *M. rattus* and *M. decumanus*.

12.—**Trichocephalus nodosus,** Rud.[4]

The male is 14-20 mm. in length, the female 23-31 mm.; the eggs, with the characteristic "tampons" at each end, measure 0.57 by 0.62 mm. This species occurs in *M. rattus*, and the house mouse *M. musculus*, and the wood mouse *M. sylvaticus*, and in species of *Arvicola*. It lives in the caecum, but is sometimes found in the intestine.

13.—**Trichosoma annulosum,** Duj.[5]

This form is shortly described by Eberth, and is figured by him. It occurs in the duodenum and small intestine of both *Mus rattus* and *M. decumanus*. Its development is probably direct, without the intervention of an intermediate host.

B. CESTODA, ADULT FORMS.

14.—**Cattotaenia pulsilla,** Goeze.[6]

Synonym. *Taenia pulsilla*, Goeze.

This species lives in the small intestine of *Mus rattus* and *M. decumanus*. For it von Janicki has recently established the new genus *Cattotaenia*.

[1] Arch. Naturg., lxiii, i, 1897, p. 30.

[2] Gurlt, Magaz. für d. gesammete Thierheilk., 1838, p. 226.

[3] Archiv path. Anat. u. Physiol., xxxvi, 1866, p. 435.

[4] Dujardin, Hist Nat. d. Helminthes., Paris, 1845, p. 35; and Goeze, Naturg. d. Eingeweidew. Blankenburg, 1782.

[5] Eberth, C. J. Untersuch. über Nematoden, Leipzig, 1863, p. 57.

[6] Goeze, J. A. E., Naturg. d. Eingeweidewürmer, Blankenburg, 1782. Archiv. Naturg. 1862, I. p. 205., von Janicki, C. Zeitschr. wiss. Zool., lxxxi, 1906, p. 575, and Zool. Anz., xxxviii.

15.—**Hymenolepis diminuta,** Rudd.[1]

Synonyms. *Taenia diminuta*, Rud, 1819.
Taenia leptocephala, Creplin, 1825.
Taenia flavo-punctata, Weinland, 1858.
Taenia varesina, Parona, 1884.
Taenia minima, Grassi, 1886.

The length of this worm is from 20-60 cms. Its second host lives in various insects, a butterfly *Asopia farinalis*, an Orthopteron *Anisolabis annulipes*, and certain beetles *Akis spinosa* and *Scaurus striatus*. Of these perhaps the first is the more frequent intermediary. The worms can be found in the rat's intestine three days after it has fed on infected insects; they attain a length of 5 mm., and at the end of fifteen days they have well-developed proglottides. *H. diminuta* occurs in the intestine of *Mus rattus*, *M. decumanus*, *M. musculus*, *M. alexandrinus*, and occasionally of man. It forms one of the three unarmed species of *Hymenolepis* which infest the genus *Mus*.

16.—**Hymenolepis microstoma** Duj[2]

Synonym. *Taenia microstoma*, Duj.

The length of this worm is 162 mm. It lives in the intestines of *Mus rattus* and *M. musculus*. It is one of the four armed species of *Hymenolepis* which live in the genus *Mus*.

17.—**Hymenolepis murina** Duj.[3]

Synonym. *Taenia murina*, Duj, 1845.
H. [*Lepidotrias*] *murina*, Weinland, 1861.

This worm measures from 25-40 mm. Grassi considers this species as identical with *H. nana* of the small intestine of man. He further thinks that *H. murina* develops without an intermediate host, and claims to have infected rats by feeding them on the mature proglottides of the worm. He describes the larval stages as developing in the thickness of the mucosa at the base of the villi. Here they increase markedly in size, and turn into cysts, which ultimately rupture the mucosa in which they are imbedded, and make their way into the intestine, where they

[1] Dujardin, M. F. Hist. nat. des Helminthes., Paris, 1845, p. 580, and Zschokke, F. Recherches sur la structure des Cestodes. Geneva, 1888., von Janicki, C. Zeitschr. wiss. Zool., lxxxi, 1906, p. 581.

[2] Dujardin, M. F., Hist. nat. des Helminthes, Paris, 1845. von Janicki Zeitschr, wiss. Zool., lxxxi, 1906, p. 581.

[3] Dujardin, M. F., Hist. nat. d. Helminthes., Paris, 1845, von Janicki, C. Zeitschr, wiss. Zool., lxxxi, 1906, p. 581.

quickly become adults. If this life-history be true, it forms an exception—unique as far as I know—of a cestode which passes both its larval —cysticercus—and its adult—scolex—stage within the body of one and the same host. *H. murina* occurs in *Mus rattus*, *M. decumanus*, *M. pumilus*, *M. musculus*, and *Myoxus quercinus*. Rats infested with *H. murina* are particularly resistant to the attacks of other Cestodes. It is one of the four armed species of *Hymenolepis* which inhabit the genus *Mus*.

18.—**Taenia ratti,** Rud.[1]

This form again wants reinvestigation. It occurs in the intestine of *Mus rattus*. Von Janicki considers it a species of very doubtful validity.

19.—**Taenia umbonata,** Molin.[2]

Another intestinal form which occurs in *Mus rattus* and *M. musculus*. Von Janicki[3] considers this a doubtful species, and Blanchard[4] thinks it may be identical with *Cattotaenia* (*Taenia*) *pulsilla*.

20.—**Bothriocephalus ratticola,** von Lins.[5]

This animal was found encysted in the liver of a rat from Singapore. It measured 12 cms., but is undoubtedly a larval form, such as is common in fish.

CESTODA, LARVAL FORMS.

21.—**Taenia crassicollis,** Rud, 1810, larval form **Cysticercus fasciolaris.**

The adult form of this tape-worm is a parasite of the small intestine of the cat, both wild and domesticated, and also of some species of *Putorius*. The larval form—*Cysticercus fasciolaris*—has a very small cyst, from which the head protrudes, followed by a long, and clearly ringed neck, but without, as yet, any trace of reproductive organs. The length of the worm varies from 3-20 cms. On being swallowed by a cat the small vesicle and these rings are absorbed, and the proglottides are formed anew at the base of the head. The cysticercus occurs in the liver of rats, mice, and bats.

[1] Rudolphi, C. A., Entozoorum Synopsis, Berolini, 1819.

[2] SB. Ak. Wien, xxx, 1858, p. 132.

[3] Zeitschr, wiss. Zool., lxxxi, 1906, p. 582.

[4] Hist. Zool. et méd des Téniadés du genre *Hymenolepis*. Bibl. gèn. de Médecine. Paris, 1891.

[5] Centrbl. Bakter., xxxvii. 1904, p. 682.

22.—**Taenia solium,** L. larval form **Cysticercus cellulosae.**

The cystic form of *T. solium*, usually found in pork, is from time to time found also in the rat, encysted in the peritoneum. There is nothing surprising in this as rats are omnivorous, eating every kind of garbage, and frequenting both the homes of humanity and the styes of pigs.

C. ACANTHOCEPHALA.

23.—**Gigantorhynchus moniliformis,** Bremser.[1]

Synonym. *Echinorhynchus moniliformis*, Bremser.

This species of Acanthocephalan inhabits various species of *Arvicola*, *Cricetus* the Hamster, *Myoxus*, and *Mus*, including *M. rattus* and *M. decumanus*. It can also infest man. The larval stage is passed in the common beetle *Blaps mucronata*, Latr.

The following Entozoa live in the brown, Hanoverian, Norwegian rat, *Mus decumanus*:—

A. NEMATODA.

24.—**Filaria obtusa,** Rud.[2]

Synonyms. *Spiroptera obtusa*, Rud.
Spiroptera murina, Leuck.

These Nematodes are found sometimes in great numbers in the stomachs of *M. decumanus* and *M. musculus*. The female averages 40 mm. in length, the male 28 mm.

25.—**Filaria rhytipleuritis,** Deslongchamps, 1824.

This form has been found in the stomach of *M. decumanus*; its larval stage is believed to be the *Mermis blattae orientalis* of Diesing, which occurs in the fat-bodies of the blackbeetle *Periplaneta orientalis*[3] The female attains a length of 20 mm., the male is shorter. *Mus rattus* has been artificially infected with this thread-worm, and probably it is readily infected in nature.

[1] Bremser, J. C., Icones Helminthum, Vienna, 1824. Hamann, O. Zool. Anz., xv. 1892, p. 165.

[2] Schneider, A. Monog. d. Nematoden. Berlin, 1866, p. 97.

[3] Galeb, O., C. R. Ac. Paris, lxxxvii, 1878, p. 75.

26.—**Filaria sp.** Davaine.[1]

Darvaine is said to have mentioned some microfilarias he had discovered in the blood of the rat, but their parentage is still a matter of doubt. I have not succeeded in finding the place referred to.

27.—**Heterakis spumosa,** Schneider.

v. No. 6, p. 75.

28.—**Oxyuris obvelata,** Bremser.

v. No. 7, p. 75.

29.—**Spiroptera sp.** Bakody.

v. No. 11, p. 76.

30.—**Strongyloides longus,** Grassi and Segrè.[2]

Synonym. *Rhabdonema longum*, Grassi and Sergè.

This form is larger than the *Str. intestinalis* of the human intestine. Its length is variable, but may reach 6 mm. It was first found in the rabbit, but has since been recorded from the sheep, the pig, the weasel, the pole-cat, and the brown rat. The development is direct, without the intervention of any intermediate host.

31.—**Trichina circumflexa,** Polonio.[3]

This form, which may very probably be identical with *Trichinella spiralis*, is mentioned by von Linstow as a parasite of *M. decumanus*, but Polonio attributes it to *Mus rattus*, probably both act as hosts. It occurs encapsuled in the peritoneum.

32.—**Trichinella spiralis,** Owen.

Synonym. *Trichina spiralis*, Owen.

This is the most important of the metazoan parasites of the rat from the human point of view, since the rat is probably the natural host from which the pig and man acquire the terrible disease of Trichinelliasis. The embryos occur encysted in the muscles, and the adults live in the intestine. It is also found in the hamster, the mouse, and other rodents.

33.—**Trichocephalus hepaticus,** Bancroft.[4]

Bancroft describes the livers of rats fed on large numbers of eggs of this worm as becoming riddled with the adults, which cause death

[1] Davaine Traité des Entozoaires.

[2] Read. Ac. Lincei (4), iii, p. 100, 1887.

[3] Lotus. 1860, p. 23.

[4] P. R. Soc. N.S. Wales, xxvii, 1893, p. 86.

in three to four weeks. The worms are 40-50 mm. in length. The development is direct without intermediate host.

I think there is little doubt that this form is identical with *Trichosomum tenuissimum* described by Leidy[1] two years before.

34.—**Trichodes crassicauda,** Bellingham.[2]

Synonym. *Trichosoma crassicauda,* Bellingham.

This worm lives in the urinary bladder, the kidneys, the ureter of *Mus decumanus.* It is described and figured by von Linstow, who says the eggs, whilst unlaid, contain embryos with a boring spine, which can be protruded and retracted. The development is probably direct. Sometimes the worms, which may be numerous, are free in the bladder sometimes attached to the wall, they are often enveloped in mucous. The males, which are very small, are said to live like the males of *Bonellia,* in the uterus of the female, three or four at a time.

35.—**Trichosoma annulosum,** Duj.

v. No. 8, p. 76.

36.—**Trichosoma papillosum,** Polonio.[3]

This is also a parasite of the urinary bladder, and may prove to be a synonym of *Trichodes crassicauda.*

37.—**Trichosoma schmidtii,** v. Lins.[4]

Von Linstow has described and figured the male of this species, which appears to be very small and very rare. It lives in the urinary bladder of *M. decumanus.*

38.—**Trichosoma tenuissimum,** Leidy.[5]

Synonym. *Trichocephalus hepaticus,* Bancroft.

v. No. 33, p. 80.

39.—**Trichosoma sp.** Railliet.[6]

This form also seems to me to be, in all probability, identical with Leidy's *Trichosoma tenuissimum,* v. No. 10 p. 80. An identical or closely similar form makes tumours in the liver of the hedgehog.

[1] P. Ac. Philad., 1890, p. 412.

[2] Eberth, J. Untersuchungen über Nematoden. Leipzig. 1863, p. 61. von Linstow, O. Arch. Naturg., xlviii, i. 1882, p. 12.

[3] Lotos, 1860, p. 23.

[4] Arch. Naturg., xl, i. 1874. p. 271.

[5] P. Ac. Philad., 1890, p. 412.

[6] Bull. Soc. Zool., France, xiv, 1889, pp. 62 and 360.

B. TREMATODA.

40.—**Distoma spiculator,** Duj.[1]

Under the above name Dujardin describes six immature individuals which he found in the small intestine of a specimen of *M. decumanus* taken at Rennes. He somewhat curiously adds that he believes them to be young specimens of *D. trigonocephalum,* since the rats in the country devour molluscs and insects as much as do small carnivora, hedgehogs, etc., which harbour the trematode.

C. CESTODA, ADULT FORMS.

41.—**Cattotaenia pulsilla,** Goeze.

v. No. 14, p. 76.

42.—**Hymenolepis diminuta,** Rud.

v. No. 15, p. 77.

43.—**Hymenolepis horrida,** v. Lins.

Synonym. *Taenia horrida,* v. Lins.[2]

Length 80 mm. This is one of the unarmed forms, and is allied to *H. relicta* and *H. diminuta.*

44.—**Hymenolepis murina,** Duj.

v. No. 17, p. 77.

45.—**Taenia brachydera,** Dies.[3]

This worm was found in the small intestine of the *Mus decumanus* in Ireland by Dr. O'B. Bellingham.[4] Von Janicki[5] considers it a doubtful species, and mentions that Blanchard thinks it may be identical with *H. microstoma.*

CESTODA, LARVAL FORMS.

6.—**Taenia crassicollis,** Rud, 1810, larval form **Cysticercus fasciolaris.**

v. No. 21, p. 78.

[1] Dujardin, M. F. Histoire Naturelle des Helminthes, Paris 1845, p. 424.
[2] Arch. Naturg, lxvii, i, 1901, p. 1.
[3] S.B Ak. Wien, xiii, 1854, p. 607.
[4] Ann. Nat. Hist., xiv, 1844, p. 322.
[5] Zeitschr, wiss. Zool., lxxxi, 1906, p. 582.
[6] Hist. zool. et. med. des Téniades du genre *Hymenolepis.* Bibl. gèn. de Médecine. Paris, 1891.

D. ACANTHOCEPHALA.

1.—Gigantorhynchus moniliformis Bremser.

v. No. 23, p. 79.

The Cestoda of the Genus Mus.

Von Janicki has recently put together a list of the adult Cestodes inhabiting the intestines of various members of this genus. Apart from some species insufficiently described, the list contains the following species; the names of those underlined occur in *Mus rattus* and *Mus decumanus*, or in one of them:—

i. Cattotaenia pusilla, Goeze, in both rats.
ii. Davainea blanchardi, Parona.
iii. Davainea celebensis, Janicki.
iv. Davainea polycalceola, Janicki.
v. Davainea gracilis, Janicki.
vi. Davainea trapezoides, Janicki.
vii. Hymenolepis contracta, Janicki, *M. decumanus*.
viii. Hymenolepis microstoma, Dujardin, *M. rattus*.
ix. Hymenolepis murina, Dujardin, in both rats.
x. Hymenolepis muris variegati, Janicki.

vii–x: with armed heads.

xi. Hymenolepis diminuta, Rudolphi, in both rats.
xii. Hymenolepis horrida, von Linstow, *M. decumanus*.
xiii. Hymenolepis relicta, Zschohke.

xi–xiii: with unarmed heads.

xiv. Hymenolepis crassa, Janicki, *M. decumanus*. Scolex unknown.
xv. Hymenolepis, sp., Janicki, *M. decumanus*.

There are further certain doubtful species, amongst which von Janicki reckons *Taenia ratti*, Rud., *T. muris sylvatici*, Rud., *T. muris capensis*, Rud., *T. musculi*. *Ptychosphysa* (*Mesocestoides*) *lineata*, Goeze = (*Taenia canis lagopodis*, Viborg), though said to occur in *Mus musculus*, apparently does not do so. The *Taenia imbricata* of Diesing and the *T. umbonata* of Molin are thought to be identical with *Cysticercus pusilla*, Goeze, whilst *T. brachydera*, Diesing, is probably synonymous with *Hymenolepis microstoma*.

Cambridge, July, 1908.

THE LIFE-HISTORY OF SYAGRIUS INTRUDENS, WATERH.

A Destructive Fern-eating Weevil.[1]

By

JOSEPH MANGAN, B.A., A.R.C.Sc. I.

With Plates VI and VII.

THE following description of the larva, pupa, and imago of *Syagrius intrudens*, may be of interest in view of the possible importance of that, and perhaps of allied species, to those concerned with the culture of Ferns. Up to the present it has been recorded solely from the Royal Botanic Gardens, Dublin, where, however, it has proved to be a most persistent and exceedingly destructive pest. For some time the Keeper of the Gardens, Mr. F. W. Moore, was troubled by the decided falling off and even complete collapse of very many of the exotic specimens in the fern-houses; the cause of these failures being by no means apparent, until an examination of the rhizomes of plants that had succumbed, or were fading, revealed the presence of this weevil. The mature insect was never to be seen above the ground during the day-time, but under cover of darkness it did considerable damage to the fronds; while the larvae, boring through the rhizomes and leaf-stalks, hollowed out the centre, eventually killing the plant. Mr. C. O. Waterhouse, (1) of the British Museum, described the weevil as a new species belonging to the Australian genus *Syagrius*. Prof. G. H. Carpenter (2) subsequently published a report of its occurrence, together with an account of the steps taken to exterminate it. I am indebted to Mr. F. W. Moore for giving me every facility for observing and procuring specimens of the insect.

Habits.

The eggs of the weevil are deposited singly in a deep pit, which is indicated externally by a small round puncture on the leaf stalk or on the rhizome. I have been unable to determine the period of hatching. The soft, white grubs, spend all their life burrowing through the larger portions of the stems, and even in the hardest parts of the rhizome, and are found rather sparely on specimens that have been attacked. One or two grubs, I have noticed, are able to execute a good deal of

[1] Read before the Association of Economic Biologists, Edinburgh Meeting, July 29th, 1908.

[Journ. Econ. Biol., 1908, vol. iii, No. 3.]

damage, the duration of the larval period being probably rather prolonged, as specimens kept under observation for some weeks showed no appreciable growth. The pupae, which are capable of rather active movements if disturbed, are found in the hollowed-out portions of rhizome and stalk-base, and in the intermingled debris. The mature weevil is nocturnal in habit, remaining in the soil during the hours of daylight. It attacks the green portion of the plants, being most destructive to the young fronds, though if it be offered nothing better it will certainly nibble at the harder parts, which it does perhaps during its sojourn below ground. The ravages of this species appear to be strictly confined to hot-house ferns, and although a majority of the genera in the fern-houses have at some time or another been subjected to attack, yet the species of *Davallia*, *Adiantum*, *Todea*, and *Nephrolepis* have endured by far the greatest devastations. *Lastrea*, *Nephridium*, *Polypodium*, and *Asplenium* are also genera which have suffered severely.

Remedies.

With a view to exterminating the insect, fumigating with tobacco was at first tried, but without effect; watering with a solution of Potassium Cyanide, and then washing out with fresh water, was successful in killing the grub only when the solution was of sufficient strength to kill the plant as well. A number of weevils, grubs, and pupae were destroyed by the laborious process of picking the roots clean of all soil, but this was very severe upon the plants. Eventually the houses were fumigated once a month during the night-time, with hydrocyanic acid, likewise an ineffectual method. The plan of steeping the plants in water was then tried, the top of the pot being placed well under the surface; after fifteen minutes of such immersion, all the weevils present in the soil are found to have taken refuge in the stems, where they can be picked off by hand and destroyed. This was found to be the most successful method of dealing with them, and after a year or two a very considerable reduction in the numbers of the insects was effected. Occasional steepings have since then served to keep them in check, and have further diminished their numbers.

Allied Forms Attacking Ferns.

The genus *Syagrius* was defined by Pascoe (3), the type before him being the Australian species *S. fulvitarsis*, from the Richmond River. He regarded it as being allied to the rare genus *Steremnius*

and referred it to the Molytides. Mr. W. W. Froggatt (4) records the appearance of this *S. fulvitarsis* from greenhouses at Sydney, where it damages the leaf-stalks of *Calipteris prolifera*, its habits being apparently similar to those of *S. intrudens*. Mr. Froggatt, however, in the same paper (4) describes a very much more destructive pest, which he terms the Maiden-hair Fern Weevil, publishing, together with his account, Mr. A. M. Lea's description of that species. Mr. Lea is of opinion that it belongs to a genus allied to, but distinct from, *Syagrius*, and terms it *Neosyagrius cordipennis*. This species is remarkably small, a circumstance which enables its grub, which, when full-grown, is only 1½ lines in length, to spend its life eating its way down the delicate leaf-stalks of the Maiden-hair Fern. The tiny Weevil, with short, heart-shaped body, spends the day-time concealed in the earth; during the night-time, it eats the fronds and deposits its eggs on the stems.

As the result of a number of experiments it was found that the best remedy was to place the ferns under water, the beetles being collected and destroyed as they came to the surface. Half an hour is sufficient to drive out the Weevils, but it appears that the ferns improve by being left over-night in lukewarm water, as not only are all the beetles driven out of the soil, but the larvae and pupae are smothered by the water which penetrates into the damaged fronds. If care is taken not to startle them by sudden light or movements, numbers may be taken by shaking the plants over paper during the night time.

In view of the habitat of the above species it seems probable that *Syagrius intrudens* has been introduced into the Botanic Gardens at Dublin from Australia, and it is more than likely that this species or related forms, will at some time claim the attention of fern cultivators elsewhere. Hence the advisability, in most cases, of subjecting newly-acquired plants to a strict quarantine, and of immersing the pots to detect the presence of the Weevil.

It may be mentioned that the grubs and imago of the native genus, *Otiorrhynchus*, are at times found together with those of *S. intrudens*, but the grubs of the latter are readily distinguished by being whiter, and having few hairs upon the body, and a more globular head.

Before proceeding to the details of the larva and pupa, I may remark that very few Weevil larvae appear to have been adequately figured and described. E. Perris (5), in his "Larves de Coléoptères," described in detail, as a Curculionid type, both larva and pupa of *Balaninus elephas*; the description, unfortunately, is not illustrated. The most complete account of a Weevil larva and pupa that I am acquainted with, is that of *Balanogastris kolae* by M. P. Lesne (6).

He lays particular stress upon the distribution of the sensory hairs of the larva and the "styli motorii" of the pupa.

STRUCTURAL DETAILS.

Egg (Pl. vi, fig. 1).—Length, 1.4 mm., smooth, opaque white, cylindrical, with sides parallel, one end more obtusely rounded than the other, twice as long as broad.

Larva (Pl. vi, figs. 2-8).—Body a pure white, with yellow-brown head, legless, skin wrinkled, rather elongate, length of largest larvae about 12 mm. when moderately extended. The head is of medium size, strongly chitinised, and decidedly globular. The frons (*f*, fig. 3) carries six characteristically situated sensory hairs, the epicranium about ten (*ep*, fig 3). The sutures (fig. 3) are markedly different from those of *Balaninus elephas* (5) and *Balanogastris kolae* (6), the apex of the frons being very obtuse, and the suture between it and the epicranial plate is on each side, at a little distance from the apex, continued on for some distance (*lat.* fig. 3) parallel to the median epicranial suture. The antennae (*a*, fig. 4) are minute, and can be made out just above, and between the ginglymus (*g*, fig. 4) and the insertion of the flexor of the mandible (*in*, fig. 4) there are not more than two segments apparent. Just above and to the outside of the antenna, on each side there is a small darkly pigmented ocellus (*o*, fig. 4). Antennae and eye-spots are similar in *Balaninus elephas* and *Balanogastris kolae*, but according to Lesne the proximal segment of antenna is only the articular membrane. The clypeus (*c*, figs. 3, 4) is distinctly articulated with the frons, and is rectangular, tapering slightly. It is small, overlaying a portion of the mandibles, and bearing no setae. In *Balanogastris kolae* the clypeus bears three pairs of sensory hairs. The labrum (side view *l*, fig. 4) is about twice as broad as long, and is rounded off distally. The anterior surface bears six sensory hairs, and the edge is furnished with ten short bristles, the two central of which are the stoutest.

The dark-coloured mandibles (figs. 4, 6) are very strong, tetrahedral in shape, and have the condyle (*co*), ginglymus (*g*), and area of insertion of the extensor muscle (*in*) prominently developed. The apex of each mandible is divided into two short teeth, and the anterior surface bears a single hair. The tendon of insertion of the flexor muscle (*fl*) is very broad, and lies in an antero-posterior plane. The maxillae (figs. 5, 7) are free from the head skeleton, and are about a third longer than the mandible. Each possesses a chitinized cardo (*cr*) and stipes (*st*), the latter bearing three delicate setae. The lacinia (*la*) is a simple process bearing at its apex and along the edge about fifteen short,

strong hairs. The palp (*pl*) is represented by a two-segmented process, which is just a little longer than the lacinia. The labium (figs. 5, 8) is clearly posterior to the maxillae, its basal portions overlapping those parts. The supporting gular region (*gl*, fig. 5) consists of soft fleshy lobes, which carry some half-a-dozen delicate hairs, and converge somewhat acutely to the apex of the labium, which is encircled by a pale brown, chitinized, cuticular band (*x*). Beyond this plate (*x*) the extremity carries a pair of two-segmented papillae (*lp*), no doubt the labial palps. On the posterior aspect of the tip, slightly internal to the palps, are a proximal pair of fine hairs and a distal pair of shorter stouter ones.

The more important folds of the cylindrical body show (fig. 2) more particularly on the ventral region, that there are twelve body segments represented. The folds of the individual segments do not appear to be so definite as those described by Lesne. The larvae is legless. The lowest of the lateral folds being, perhaps, to some extent, of service as pro-legs; in the abdominal regions these folds carry two, and in the thoracic region a few more, setae. More decided vestiges of the legs appear to exist in *Balanogastris kolae*. There is a decided pronotal plate (*pr*), which is lightly tinted with brown; it carries a couple of hairs. The general surface of the body is furnished with a very few small, scattered setae; however, segments eleven and twelve each carry some half-a-dozen characteristically placed elongate hairs. "Spinules tégumentaires," such as are described in *Balanogastris kolae*, are absent from the integument. Spiracles, which are marked by a faint brownness of the cuticle, are present upon the first thoracic and on the first eight abdominal segments.

Pupa (Pl. vii, figs. 1-2).—Length variable, averaging 6 mm. in examples met with. White. Surface conspicuously spiny, with numerous short setae, each borne upon a soft conical papilla; these, termed "styli motorii," by Lesne, are most probably locomotive in function. The head is smooth, with the exception of seven pairs of setiferous papillae, which are situated at intervals, on each side of the middle line, along the forehead (*fr*) and rostrum (*r*). The proportions of the antenna are somewhat different from those of mature insect, the scape being relatively very much shorter, and coming off from the middle of the rostrum. The prothorax (*p*) carries two pairs of centrally situated setae; seven or eight of smaller size extending over the lateral surface on each side. The mesothorax (*m*) bears across its dorsal surface some half-dozen setae. The elytra arise laterally, taper to a point, and have their surface marked by ten or so longitudinal grooves. The elytra are embraced between the second and third thoracic legs of

each side. At the femoro-tibial articulation, there are on each of the legs a pair of setae. The metathoracic segment is indicated by a slight setiferous prominence, the abdominal segments being more decidedly ridged off. The first seven of these latter segments bear dorsally situated rows of eight, or at most ten, setae ; the eighth carries but two. In *Balanogastris kolae* the hairs are everywhere distributed in accordance with the same plan, but are fewer in number. The anal segment (not regarded as separate segment by Lesne) has a pair of small posteriorly directed processes (*ap*), which are each furnished with three minute hairs and terminated by a single, curved, chitinous bristle. A pair of similar processes are present in *Balaninus elephas* and *Balanogastris kolae*. The spiracles which I have observed are :—A pair on the metathorax anterior to the very small wing rudiments, and a pair upon each of the eight succeeding segments, in front of and slightly below the most laterally situated of the dorsal setae.

Imago (Pl. vii, figs. 3, 4, 5).—To accompany the figures of the adult Weevil, I append below Mr. F. P. Pascoe's (3) definition of the genus, and Mr. C. O. Waterhouse's (1) diagnosis of this species. I may add, that the short, light-brown pubescence, very conspicuous on actual specimens, does not appear so distinctly in figures 3 and 4. On removing the elytra the dorsal abdominal tergites are seen to be exceptionally soft, the wings appearing as minute scales. In some specimens I found the elytra were united, in others free.

Genus Syagrius, Pascoe.

"*Rostrum* modice elongatum, arcuatum ; *scrobes* praemedianae, obliquae, infra rostrum currentes. *Oculi* ovales, grosse granulati. *Scapus* oculum haud attingens ; *funiculus*, 7-articulatus articulis extus gradatim crassioribus. *Prothorax* lateribus rotundatus, basi rectus ; lobis ocularibus nullis. *Scutellum* invisum. *Elytra* cylindrica, prothorace haud latiora. *Coxae* posticae rotundatae ; *femora* mutica, antica majora ; *tibiae* flexuosae, muticae ; *tarsi* breves, latiusculi ; *unguiculi* liberi. *Abdomen* segmentis duobus basalibus ampliatis, sutura prima distincta."

Syagrius Intrudens, Waterhouse.

"Elongatus, crassus, subparallelus, picco-niger, parum nitidus, rugosus ; antennis tarsique piceis. Long. 7-10 mm.

"Rostrum gently arcuate, thick, with a fine median smooth line, and with a groove on each side above the antennal groove ; the apex shining and finely punctured. Forehead rugosely punctured, with a well-marked impression in the middle. Thorax with its broadest part

in front of the middle, a trifle narrower at the anterior angles than at the posterior; the sides arcuate; the base exactly fitting the base of the elytra, but a trifle narrower. The surface very uneven, consisting of closely packed irregular obtuse tubercles, some of which are shining. The interspaces with very short brownish pubescence. Elytra very convex, humped up at the suture, with a slight constriction at the base, gradually widening from this to the apical declivity, where they are as wide as the widest part of tht thorax. Apical declivity almost vertical. The region of the scutellum and some irregular, rather oblique, vermiculate impressions dull black. The rest of the surface covered with very irregular more or less confluent tubercles, which are themselves ornamented with very small shining tubercles. Near the suture, just at the apical declivity, there are two tubercles, which are rather more prominent than the others; these and some of the others have more or less brownish hair on them. There are also some of these short brown hairs just within the humeral angle. At the sides there are two or three rows of elongate deep foveae.

"The punctuation of the basal portion of the rostrum varies very much. Some specimens have it closely and rugosely punctured; in others the punctures are separated and the surface is shining. This difference is no doubt sexual. This species resembles *S. fulvitarsis*, Pascoe, but the rostrum is less strongly curved, and the tubercles on the dorsal surface of the thorax and elytra are much more numerous. In *S. fulvitarsis* the dull black surface is greater than that occupied by the tubercles; in *S. intrudens* the reverse is the case."

REFERENCES.

1. **Waterhouse, C. O.**—Description of a new Coleopterous Insect belonging to the Curculionidae. Ann. Mag. Nat. Hist., 1903 (7), vol. xi.

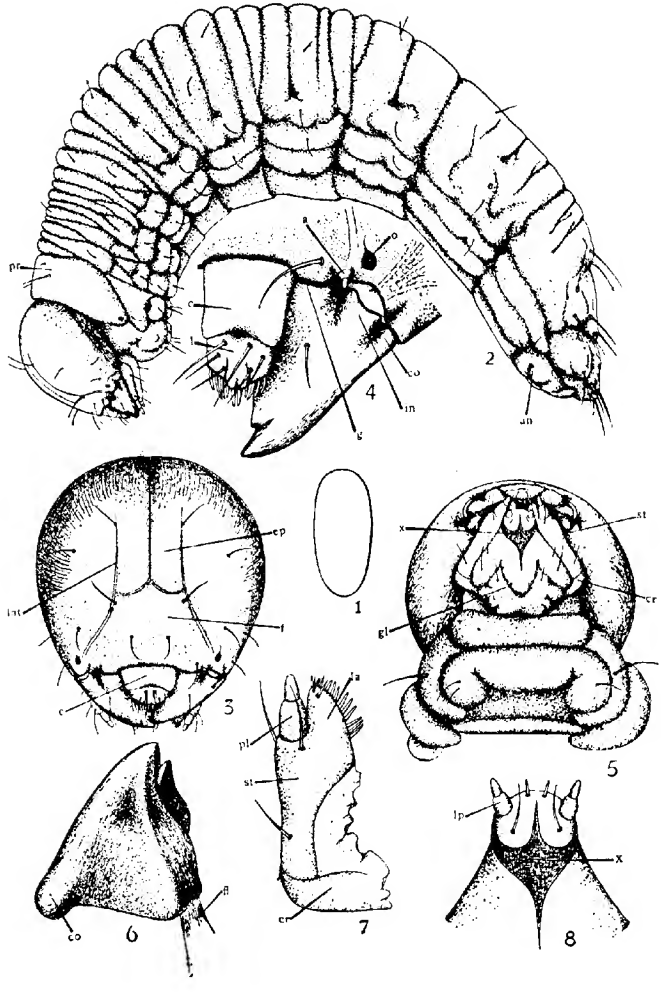
2. **Carpenter, G. H.**—Injurious Insects observed in Ireland during the year 1902. Econ. Proc. R. Dub. Soc., 1903. Vol. i, p. 204.

3. **Pascoe, F. P.**—Additions to the Australian Curculionidae. Ann. Mag. Nat. Hist., 1875 (4), vol. xvi.

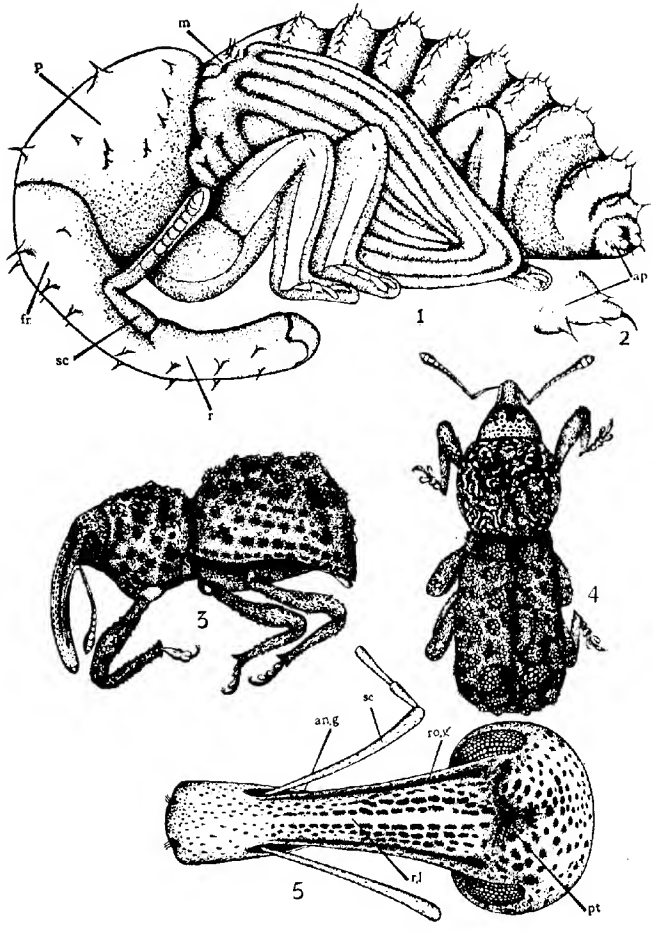
4. **Froggatt, W. W.**—Some Fern and Orchid Pests. Agric. Gazette N.S. Wales, 1904, vol. xv, part 6, p. 516.

5. **Perris, E.**—Larves de Coléoptères. Ann. Soc. Linn. d. Lyon, 1877. (n.s.), xxiii, pp. 207-251.

6. **Lesne, P.**—Description de la Larve et de la Nymphe du Charançon de la Noix de Kola. Bull. Mus. Hist. Nat. Paris, 1898, iv, pp. 140-147.



SYAGRIUS INTRUDENS, Waterh.



SYAGRIUS INTRUDENS, Waterh.

DESCRIPTION OF PLATES VI AND VII.

Illustrating Mr. Joseph Mangan's paper on "The Life-History of *Syagrius intrudens*," Waterh.

PLATE VI.

Fig. 1.—Egg of *Syagrius intrudens*. × 15.
Fig. 2.—Larva of *S. intrudens* viewed from the side. × 19.
Fig. 3.—Head of same viewed from in front. × 33.
Fig. 4.—Labrum and mandible viewed rather laterally: also showing the left antenna and ocellus. × 78.
Fig. 5.—Head and mouth-parts viewed from below, with the head pressed slightly upwards. × 33.
Fig. 6.—Right mandible viewed from behind. × 78.
Fig. 7.—Right maxilla do. do.
Fig. 8.—Labium do. do.

a, antenna; *an*, anus; *c*, clypeus; *co*, condyle; *cr*, cardo; *ep*, epicranium; *f*, frons; *fl*, tendon of insertion of flexor muscle of the mandible; *g*, ginglymus; *gl*, gular lobes; *in*, insertion of extensor muscle of the mandible; *l*, labrum; *la*, lacinia; *lat*, lateral continuation of epicranial suture; *lp*, labial palp; *o*, ocellus or eye spot; *pl*, maxillary palp; *pr*, pronotal plate; *st*, stipes; *x*, sclerite on posterior surface of labium.

PLATE VII.

Fig. 1.—Pupa of *S. intrudens* viewed from the side. × 21.
Fig. 2.—Left process of anal segment of pupa. × 53.
Fig. 3.—Imago of *S. intrudens* viewed from the side. × 8.
Fig. 4.—Dorsal view of same. × 8.
Fig. 5.—Head and rostrum of same viewed from in front. × 21.

an.g, antennal groove; *ap*, process of anal segment; *fr*, forehead; *m*, mesothorax; *p*, prothorax; *pt*, pit-like depression on forehead; *r*, rostrum of pupa; *r.l*, smooth median line on rostrum; *ro.g*, superior rostral groove; *sc*, scape of antenna.

REVIEWS.

Connold, E. T.—British Oak Galls. Pp. xviii + 169, 68 plts. and 17 text figs. London: Adlard & Son, 1908. Price net.

There is so much excellent foreign literature upon Galls and Gall-makers that we opened Mr. Connold's book with great expectations, only to have our hopes disappointed. At times we have had occasion to refer to the beautifully illustrated and lucidly written works of Keiffer, Houard, Trotter, Giraud, Perez, and other Continental writers, and possibly after the excellent descriptions that are to be found in such works, we came expecting too much. However, the fact remains, that the information given in this book, like that in the author's previous one on "British Vegetable Galls," is of the scantiest.

There is an abundant literature on Oak Galls and their inhabitants, and we are sorry that the author has not made greater use of the same.

The half-tone illustrations are all excellent, indeed quite equal to any we have seen of galls, and the objects have been selected with care and discrimination. Such an admirable series of figures go a long way to redeem many shortcomings in this book, and will be a source of help to all who are interested in British Oak Galls.

W. E. C.

Darwin, Charles.—Insectivorous Plants. Revised by Francis Darwin. Pp. xiv + 377, 30 illustrations. London: John Murray, 1908. Price 2s. 6d. net.

The issue of a popular edition of Darwin's fascinating work on Insectivorous Plants will be welcomed by a large body of naturalists, whilst it places within the reach of the rising generation all but one of Darwin's great works published by Mr. John Murray.

Since it was first published, now thirty-three years ago, much valuable work has been done; great strides have been made in the study of vegetable physiology, and experimental botany, but, as with all the author's works, time does not lesson their interest.

All who take an interest in plant life will read the book with a keen appetite, whilst to naturalists generally its perusal is still a part of their education.

At a time when Natural History Societies are stocking their book-shelves with much illustrated literature of an ephemeral nature, we would strongly advise the addition of the Popular edition of Darwin's works, which Mr. Murray has placed before the public in such an admirable style.

W. E. C.

Fisher, W. P.—Forest Utilization. Vol. V. Schlich's Manual of Forestry. Second Edition. Pp. xxii + 840, 5 plts. and 402 text figs. London: Bradbury, Agnew & Co., Ltd., 1908. Price 12s. net.

All students of forestry will welcome the second edition of Professor Fisher's valuable work on Forest Utilization. Since its publication in 1896, it has been regarded by all competent authorities as the leading and most comprehensive work on the subject.

Founded upon a translation of Gayer's "Die Forstbenutzung," which like most great works had become such whilst passing through a series of editions, nine in all, dating from 1863 to 1903, the author has made numerous additions in the form of notes, and has generally brought the subject up-to-date, so that it now remains the standard work in the English language on this important subject, and cannot fail but prove of great use and value to all students and practical foresters.

With the renewed interest which is now being taken in forestry in this country, we can only hope that the second edition will be even more successful than the first, of which 1,500 copies were issued in 1896.

W. E. C.

Janet, Charles.—Anatomie du Corselet et Histolyse des Muscles Vibrateurs, apres le Vol Nuptial chez la Reine de la Fourmi *Lasius niger*. Pp. 149 + 20, 13 plts. and 45 text figs. Limoges: Ducourtieux et Gout., 1908.

Of all the memoirs of M. Janet's great work "Études sur les Fourmis, les Guêpes et les Abeilles," of which this is the twenty-sixth, none are more beautifully produced or greater in interest.

Like all this author's work, it is as near perfection as unwearied and patient research can make it, indeed it is not too much to say that amongst the many magnificent works on insects—systematic and anatomical—it is not surpassed for accuracy of detail and faithful minutiae.

The work lends itself to a division into two parts, the first treating of the pairing, nest founding and nuptial flight; and the second and major portion of the work of the histolysis of the flight-muscles and the detailed structure of the thoracic exoskeleton.

The degeneration of the great flight-muscles, functional during the life of the queen-ant for only a few hours, the enrichment of the vascular system by their broken down constituents, and the consequent supply of food necessary for the production of a large number of eggs and the nourishment of the larvae, is described in great histological detail with a full appreciation of its vast physiological import.

No student of insect anatomy or insect bionomics can afford to overlook this magnificent work, which is characterised by wonderful detail and accuracy, beautiful illustrations, and a lucidity to be envied.

W. E. C.

Johnstone, James.—Conditions of Life in the Sea. Pp. xiv + 332, 1 plt. and 31 figs. Cambridge: The University Press, 1908. Price 9s. net.

There is at present no adequate summary in English, the author informs us, of the main results of modern quantitative marine biological investigations, we therefore welcome Mr. Johnstone's work as an admirable and valuable piece of work.

The book is divided into three parts, the first supplying a general account of the main facts of oceanography; part ii. deals with the methods and results of quantitative marine biological research; and part iii. with the general conditions of life in the sea.

To condense into three hundred pages an account of these three sections is no easy task, much of the matter upon which they are founded is of a highly technical nature, and such as requires the most careful discrimination, and admittedly imperfect and incomplete as are the investigations, a fact freely admitted by the author, they nevertheless have been handled with such skill as to form a most fascinating whole.

The distribution of the plankton, the productivity of the sea, the conditions of life and the bacteria of the sea, are chapters specially commendable, and full of thoughtful work that must appeal to all who take an intelligent interest in modern biological development.

Mr. Johnstone has been at some pains to bring the information now given up-to-date, whilst a short bibliography, together with numerous references in foot-notes, will enable the reader to at once tap the original sources of information.

Enough has been said to show that this is a work of considerable interest, and cannot fail to appeal to a large number of readers.

W. E. C.

Pearson, J.—L. M. B. C. Memoirs. XVI. Cancer. Pp. viii + 209. Plts. i-xiii and 12 figs. London: Williams & Norgate, 1908. Price 6s. 6d.

The subject of this memoir, *Cancer pagurus*, the edible crab of this country, is an animal of great economic importance and zoological interest.

So far as the morphology is concerned the author has given an excellent account of both the external and internal structure, but we should have welcomed more fuller details under the section Economics and Bionomics.

Why the figures illustrating this valuable series of memoirs should be reproduced in a sooty-coloured ink instead of a deep black, and on tinted instead of white paper, is a mystery unknown to us, but whatever the cause it greatly depreciates their value.

W. E. C.

Poulton, E. B.—Essays on Evolution, 1889-1907. Pp. xlviii + 480, 1 plt. and 7 text figs. Oxford: The Clarendon Press, 1908. Price 12s. net.

The eleven essays included in this volume deal mainly with the subject of mimicry, to the literature of which they are a valuable addition.

The introduction will be read with considerable interest, for Professor Poulton enters a strongly worded protest against the narrowness and prejudice apparent in the earlier works of Bateson on Variation, and has some equally pertinent remarks on the "grotesque exaggeration" of other Mendelians. He contends that the conclusions supported in the present volume are inconsistent with a theory of evolution by Mutation, inconsistent with the views often expressed by Mendelians, but not inconsistent with the discoveries of Mendel himself.

Excepting the first, the Introduction, and the seventh essay, all have been published some time, but the author has revised and modified them since, and made many additions to the text and footnotes.

In much that Professor Poulton regards as Mimicry we are unable to follow him, but most biologists will welcome his trenchant criticism of Mendelism.

It has been evident for some time past that there was gradually creeping into Mendelian literature an "amount of dogmatism concerning work which the writer was evidently imperfectly acquainted" with, and that assumptions were being made on the slenderest evidence. Professor Poulton thinks that the Mendelian "is to some extent paralysed by his own work," but whether this be so or not, it is no excuse for appropriating under the name of Mendel the results of Weissman, or the contemptuous depreciation of the work of others.

The author strikes boldly, but fairly throughout, and we welcome his outspoken defence and criticism.

The work concludes with a most useful and carefully compiled analytical index, extending over eighty printed pages.

W. E. C.

Shipley, A. E.—Pearls and Parasites. Pp. xv + 232, 10 illustrations. London: John Murray, 1908. Price 7s. 6d.

Since Huxley published his justly popular "Essays and Addresses," there have been few scientific essayists who have commanded more than passing attention. Some are curt and uninteresting, others verbose and wearisome.

The author of the interesting volume before us seems to have hit the happy medium, and whether writing on "British Sea-Fisheries," "Malaria," or of the claims of the University of and in which he is so distinguished an ornament and worker, there is the same graceful charm and lucidity, full of freshness and keen interest.

Most of the nine essays we have had the pleasure of reading before, but in perusing them for a second time they have lost none of their original interest, and we welcome them in book form for future reference.

Few men are more competent than Mr. Shipley to pronounce an opinion on such subjects as our sea-fisheries, malaria, parasitic diseases due to flies, pearl fisheries, and the financial needs of Cambridge University, and all who are interested, even in the slightest degree, in these subjects, will read this work with both pleasure and profit.

W. E. C.

Thomson, J. Arthur.—Heredity. Pp. xvi + 605, 49 illustrations. London: John Murray, 1908. Price 9s. net.

Amidst the voluminous, and often very dogmatic, literature dealing with the important subject of Heredity, it is refreshing to find a calm, tolerant, lucid, and comprehensive work like the one before us. It is not too much to say that the most outstanding feature is the fair and kindly manner in which all views are presented.

We have just stated that the work is lucid and comprehensive, and on this account alone far surpasses any book we know of for the beginner, or he would have marshalled before him the facts and fancies upon which our ideas of heredity are founded.

Whilst there are many controversial matters on which we strongly differ from Prof. Thomson's view, we put these aside for the present, in acknowledgment of the admirable survey he has given us of a most complicated subject in a manner uncommon to works on such subjects.

If the book has a fault, it is the insufficient critical spirit, but when one reflects that two-thirds of the so-called scientific criticism of the present day is such childish and puerile fault finding, we are glad to find only such criticism as "is the ripe fruit of combined intellectual insight and long experience," and not the petty jealousies unworthy of seekers after truth.

The book is beautifully illustrated, contains an excellent bibliography and subject index to the same, and a full index.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

Burgess, A. F.—Description of new devices for rearing Insects. Journ. Econ. Entom., 1908, vol. i, pp. 267-269, plts. 3, 4.

II.—Anatomy, Physiology, and Development.

Gahan, C. J.—On the Larvae of *Trictenotoma childreni*, Gray, *Melittomma insulare*, Fairmaire, and *Dascillus cervinus*, Linn. Trans. Entom. Soc. Lond., 1908, pp. 275-282, plt. vi.

Imms, A. D.—On the Larval and Pupal Stages of *Anopheles maculipennis*, Meigen. Parasitology, 1908, vol. i, pp. 103-133, plts. ix, x.

Paoli, G.—Intorno all'organo del Graber nelle larve di Ditteri Tabanidi. Redia, 1907, vol. iv, pp. 247-258, 6 figs.

Vickery, R. A. A Comparative Study of the external anatomy of Plant Lice. 12th Rpt. State Entom. St. Anthony Park, Minn., 1908, pp. 1-16, 5 figs.

Wesché, W.—Notes on the value of the genitalia of insects as guides in Phylogeny. Trans. Entom. Soc. Lond., 1908, pp. 297-305.

III.—General and Systematic Biology, and Geographical Distribution.

Berlese, Antonio.—Considerazioni sui rapporti tra piante, loro insetti nemici e cause nemiche di queste. Redia, 1907, vol. iv, pp. 198-246.

Berlese, Antonio. Istruzioni pratiche per coloro che vogliono rinnovare le esperienze do lotta contro la mosca delle olive col metodo dachicida. Ibid., pp. 193-197.

Berlese, A., Del Guercio, G., Paoli, G.—Osservazioni sopra un recente scritto relativo ad insetti nocivi all'Olivo. Ibid., pp. 259-328.

Börner, C.—Eine monografische Studie über die Chermiden. Arb. Biol. Anstalt f. Land-u. Forstw., Berlin, 1908, Bd. vi, Heft. 2, pp. 239, 3 tav. e 101 fign.

Buffa, P.—Alcune notizie anatomiche sui Tisanotteri Tubuliferi. Redia, 1907, vol. iv, pp. 369-381, 17 figs.

Buffa, P.—Esame della Raccolta di Tisanotteri italiani esistente nel Museo Civico di Storia Naturale di Genova. Redia, 1907, vol. iv, pp. 382-391, 5 figs.

Carpenter, Geo. H.—On Two Collembola new to the Britannic Fauna. Irish Nat., 1908, vol. xvii, pp. 174-179, 8 figs.

The two new forms are *Isotoma tenella*, Reuter, and *Agrenia bidenticulata* (Tulb.) var. nov. *elongata*.

Cockerell, T. D. A.—Fossil *Cercopidae* (Homoptera). Bull. Winconsin Nat. Hist. Soc., 1908, vol. vi, pp. 35-38.

Cooper, W. F., and Robinson, L. E.—On six new species of *Ixodidae*, including a second species of the new genus *Rhipicentor*, N. & W. Proc. Camb. Phil. Soc., 1907, vol. xiv, pp. 457-470, 24 figs.

Fuschini, C.—Contributo allo studio della *Phylloxera quercus*, Boyer. Redia, 1907, vol. iv, pp. 360-368.

Green, E. E.—Remarks on Indian Scale Insects (Coccidae) Pt. III. Mem. Dept. Agric. India, Entom. Ser., 1908, vol. ii, no. 2, pp. 15-46, plts. ii-iv.

Describes 1 new genus, 18 new species, and 1 new variety. There is a useful Catalogue of Indian Coccidae of 102 species.

Lebour, Marie V.—Fish Trematodes of the Northumberland Coast. Northumberland Sea Fisheries Comm. Rpt. for 1907, 1908, pp. 23-67, plts. i-v.

An important contribution to the subject. One genus and six species are described as new.

Marlatt, C. L.—New species of Diaspine Scale Insects. Ibid., Tech. Ser. No. 16, pt. ii, pp. 11-32, plts. i-ix.

The author describes 17 new species, four of which are apparently native to the American Continent, and the remainder foreign. All are of potential economic importance, as indicated by the place of origin and the host plants.

It is most unfortunate that none of the species are figured, beyond some very indistinct figures from photo-micrographs of the anal plates.

Newell, W.—Two interesting Inquilines occurring in the nests of the Argentine Ant. Journ. Econ. Entom., 1908, vol. i, pp. 262-265.

Nuttall, G. H. F., and Warburton, C.—On a new genus of *Ixodoidea*, together with a description of eleven new species of ticks. Proc. Camb. Phil. Soc., 1907, vol. xiv, pp. 392-416, 45 figs.

Nuttall, G. H. F., Cooper, W. F., and Robinson, L. E.—The Structure and Biology of *Haemaphysalis punctata*, Canestrini and Fanzago. I. Parasitology, 1908, vol. i, pp. 152-181, plts. xii-xvi, and 9 text figs.

Ribaga, C.—Di una peculiare alterazione delle foglie di Gelso dovuta ad un Omottero. Redia, 1907, vol. iv, pp. 329-333, T.v.

Sanderson, E. D.—The Influence of Minimum Temperatures in limiting the Northern Distribution of Insects. Journ. Econ. Entom., 1908, vol. i, pp. 245-262, 7 maps.

Shipley, A. E.—Note on *Cystidicola farionis*, Fischer. A Thread-worm parasitic in the Swim-bladder of a trout. Parisitology, 1908, vol. i, pp. 190-192.

III.—Agriculture and Horticulture.

Ballou, E. A.—Cacao Thrips. W.I. Bull, 1908, vol. ix, pp. 190-192, 2 figs.

Carpenter, Geo. H.—Injurious Insects and other Animals observed in Ireland during the year 1907. Econ. Proc. Roy. Dublin Soc., 1908, vol. i, pp. 559-588, plts. xlix-liv, and 10 text figs.

Chittenden, F. H.—The Asparagus Beetles. U.S. Dept. Agric., Bur. of Entom., Circ. No. 102, 1908, pp. 1-12, figs. 1-6.

Chittenden, F. H.—The Harlequin Cabbage Bug. (*Murgantia histrionica*, Hahn.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 103, 1908, pp. 1-10, 1 fig.

Chittenden, F. J.—Apple Leaf Spot. Journ. Roy. Hort. Soc., 1908, vol. xxxiii, pt. ii, pp. 500-511, figs. 89-91.

Chittenden, F. J.—A Disease of the Cineraria. Journ. Roy. Hort. Soc., 1908, vol. xxxiii, pt. ii, pp. 511-513, figs. 92, 93.

Collinge, Walter E.—The Possibility and Danger of the Introduction of the San José scale into Great Britain. Proc. Assoc. Econ. Biol., 1908, vol. i, pp. 171-178.

Coudon, F. D.—A Gall-Maker of the Family *Agromyzidae*. (*Agromyza liliae*, n.sp.). Proc. Entom. Soc. Washington, 1908, vol. ix, pp. 1-4, 1 fig.

Del Guercio, G.—Notizie intorno a due nemici nuovi e ad un noto nemico dell 'olivo mal conosciuto, con un cenno sui rapporti di uno di essi con i microsporidi. Redia, 1907, vol. iv, pp. 334-359, 14 figs.

Evans, I. B. P.—Potato Scab. *Oospora scabies*, Thaxter. Transv. Agric. Journ., 1908, vol. vi, p. 576, plt. 77.

Evans, I. B. P.—Anthracnose or Zwart Roest of the Grape. (*Gloeosporium ampelophagum*, Sacc.). Ibid., pp. 577-580, plts. 78-80.

Felt, E. P.—Notes on the Work against the Gypsy Moth. Journ. Econ. Entom., 1908, vol. i, pp. 275, 276.

Fernald, H. T. The Fundamental Principles of Spraying. Journ. Econ. Entom., 1908, vol. i, pp. 265-267.

Gunning, J. W. Locusts Birds. Transv. Agric. Journ., 1908, vol. vi, pp. 527-530.

Güssow, H. T.—The Predisposition of Plants to Parasitic Diseases. Proc. Assoc. Econ. Biol., 1908, vol. i, pp. 158-170.

Henderson, L. F.—Spraying Experiments for 1907. Univ. Idaho Agric. Exp. Stat., Bull. No. 61, 1908, pp. 1-15.

Hinds, W. E.—The First and Last essential step in combating the Boll Weevil. Journ. Econ. Entom., 1908, vol. i, pp. 233-243.

The author states in conclusion—"The question here presented is a vital one for the weevil infected area. It demands not merely acquiescence, but action. The accuracy of the facts presented cannot be questioned, but each man must decide for himself as to the correctness of the conclusions. To us it appears that this statement does abundantly justify the broad, general conclusion that the destruction of stalks by some effective method and as long as may be possible before the normal time for weevils to enter hibernation constitutes the most effective method now known of reducing the severity of the weevil attack upon the following crop, and that it therefore deserves general recognition and adoption as the last step in the treatment of each season's crop, and essentially the first step also in the production of a crop with the minimum weevil injury during the following season."

Hooper, C. H.—The Commoner Birds of our Gardens: their Habits and Foods. Journ. Roy. Hort. Soc., 1908, vol. xxxiii, pt. ii, pp. 427-450.

Howard, C. W.—The Codling Moth. Transv. Agric. Journ., 1908, vol. vi, pp. 523-526, plt. 62.

Howard, C. W.—Notes on Transvaal Tobacco Pests. Ibid., pp. 609-616 plts. 81, 82, and 4 text figs.

Howard, L. O.—The Carpet Beetle, or "Buffalo Moth" (*Anthrenus scrophulariae*, L.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 5, revised ed., 1908, pp. 1-4, 1 fig.

Lefroy, H. M.—The Red Cotton Bug (*Dysdercus cingulatus*, Fabr.). Mem. Dept. Agric. India, Entom. Ser., 1908, vol. ii, no. 3, pp. 47-58, plt. v.

Lefroy, H. M.—The Castor Semi-Looper (*Ophiusa melicerte*, Dr.). Ibid., no. 4, pp. 59-77, plts. v and vii, 3 text figs.

Lefroy, H. M.—The Tobacco Caterpillar (*Prodenia littoralis*). Ibid., no. 5, pp. 79-93, plt. viii, 1 text fig.

Lefroy, H. M.—Imported Insect Pests. Agric. Journ. India, 1908, vol. iii, pp. 237-244.

Lefroy, H. M. Insect Pests of Mangel Wurzel. Agric. Journ. India, 1908, vol. iii, pp. 152-160.

Lefroy, H. M., and Ghosh, C. C.—The Mustard Sawfly (*Athalia proxima*, Klug.). Mem. Dept. Agric. India, Entom. Ser., 1908, vol. i, no. 6, pp. 357-370, plt. xx.

Lounsbury, C. P.—The Fusicladium Disease of the Pear and Apple. With notes on other Spot Diseases of these Fruits. Agric. Journ. C. of G. H., 1908, vol. xxxiii, pp. 16-32.

Lounsbury, C. P.—Woolly Aphis and Tobacco Extract. Agric. Journ. C. of G. H., vol. xxxiii, pp. 188-193, 1 fig.

Mackenzie, M., and Lefroy, H. M.—The Sugarcane Borers of Behar. Agric. Journ. India, 1908, vol. iii, pp. 104-124, plts. xx-xxii.

Mally, C. W.—Bee Pirates. Agric. Journ. C. of G. H., 1908, vol. xxxiii, pp. 206-213, 4 figs.

Marlatt, C. L.—The Woolly Aphis of the Apple. *Schizoneura lanigera*, Hausmann. U.S. Dept. Agric., Bur. of Entom., Circ. No. 20, rev. ed., 1908, pp 1-6, 2 figs.

Newell, W., and Barber, T. C.—Preliminary Report upon Experiments with Powdered Arsenate of Lead as a Boll Weevil Poison. State Crop Pest Comms. of Louisiana, No. 23, 1908, pp. 9-40, 3 figs.

Newell, W.—Destroying the Boll Weevils before they enter hibernation. State Crop Pest Comms. of Louisiana, Circ. No. 24, 1908, pp. 41-48.

Newell, W., and Treherne, R. C.—A new predaceous enemy of the Cotton Boll Weevil. Ibid., pp. 244.

A Carabid known as *Evarthrus sodalis*, Lec.

Patel, C. U.—Katra (Hairy Caterpillars) in Gujarat. Agric. Journ. India, 1908, vol. iii, pp. 152-160.

Powell, H.—*Oryctes monoceros,* or large horned cocoanut beetle. Agric. Journ. Brit. E. Afr., 1908, vol. i, pp. 58, 59.

Sanderson, E. D.—Caterpillars injuring Apple foliage in late Summer. New Hampshire Agric. Exp. Stat., 1908, Bull. 139, pp. 207-228, 1-13.

Stockdale, F. A.—Root Disease of Sugar Cane. W.I. Bull., 1908, vol. ix, pp. 103-116.

This disease in the West Indies is chiefly caused by *Marasmius sacchari,* but it is thought that other fungi may be the cause of some of the damage noticed.

The symptoms, distribution, and spread of the disease are discussed together with remedial measures.

Stockdale, F. A.—Fungus Diseases of Cacao and Sanitation of Cacao Orchards. Ibid, pp. 166-189.

V.—Forestry.

VI.—Fisheries.

VII.—Medicine.

Girault, A. A.—The Indian Bedbug and the Kala Azar Disease. Science, 1907 (n.s.), vol. xxv, p. 1004.

Howard, L. O.—How Insects affect Health in Rural Districts. U.S. Dept. Agric., Farmers' Bull. No. 155, 1908, pp. 1-19, 16 figs.

Jackson, D. D.—Pollution of New York Harbor as a menace to health by the dissemination of Intestinal Diseases through the agency of the Common House Fly. Merchants' Assoc. New York, 1908, pp. 1-22, 7 plts.

A very valuable report showing a condition of sanitation and an apathy on the part of the Authorities that one would not have conceived possible in any civilized and educated community.

Manson, Patrick.—Recent Advances in Science and their Bearing on Medicine and Surgery. Lancet, 1908 (Oct. 3), pp. 991-997.

Navarre, P. J.—Les insectes inoculateurs de maladies infectieuses. Mém. Acad. Sci. Lyon, 1907 (3), T. 9, pp. 1-56, plts. i-v, 19 figs.

VIII.—Animal Diseases.

Anon.—East Coast Fever Legislation. Bill to Amend Previous Acts. Natal Agric. Journ., 1908, vol. xi, pp. 1020-1023.

Borrel, A.—Lympho-sarcome du chien. C. R. Acad. Sci. Paris, 1907, T. 144, pp. 344, 345.

Cameron, S. S.—Parasitic Skin Diseases. Journ. Dept. Agric. Victoria, 1908, vol. vi, pp. 444-448.

Donitz, W.—Die Texasfieberzecke *Boophilus annulatus*, und das Ixodinengenus *Margaropus*. Sitz.-Ber. Gesell. nat. Freunde Berlin, 1907, pp. 187-192.

Gates, B. N.—Bee Diseases in Massachusetts. U.S. Dept. Agric., Bur. of Entom., Bull. No. 75, Pt. III, 1908, pp. 1-32, plt. iv.

Saigol, R. O.—Experiments on "Rat Extermination." Indian Med. Gaz., 1908, pp. 254-256.

As a result of experiments made with various much advertised preparations the writer concludes: "Although hope had been extended from many quarters that rat extermination would be practicable by employing some micro-organism which would not only produce a disease in the animals directly experimented upon, but an infectious fatal disease among the rat population as a whole through these diseased rats being let loose, this has not been borne out by the experiments given above.

Supposing an organism is capable of producing an infectious, communicable disease among the rodents, it must do so through the infection being carried about in one or more of the following ways:—(1) by discharges; (2) by suctorial insects; and (3) by food (eating carcases).

That none of these means was potent enough in the case of any of the bacillary preparations experimented upon by me, is evident from the results. Further, no organism could be more virulent for rodents than the bacillus pestis, and yet rodents have not only not been decreased to any appreciable extent, but continue in such large numbers as to require special means to get rid of them.

The position therefore remains as it was before, and further experience will teach us what are the ways in which rats can be best got rid of, or whether measures ensuring the exclusion of free rats coming in contact with human beings would not be more beneficial as against rat extermination to which, practically, there seems no end."

Stiles, C. W., and Hassall, A.—Index Catalogue of Medical and Veterinary Zoology. U.S. Dept. Agric., Bur. An. Indus. Bull. No. 39, pts. 20 and 21, 1908, pp. 1493-1624.

Theiler, A. Experiments with English and South African Redwater. Transv. Agric. Journ., 1908, vol. vi, pp. 534-543.

First Report of the Select Committee on East Coast Fever. Pp. xxxiv + 86 + v. Cape Town: 1908.

Stock-owners and veterinarians will welcome this First Report, for it places in their hands an authoritative statement on a disease which we are informed causes the loss of 95 per cent. of the cattle attacked.

The disease is spread by five species of ticks of the genus *Rhipicephalus*, and so far as is at present known this is the only means of communicating the disease from one animal to another.

The evidence of Messrs. P. J. du Toit, J. D. Borthwick, C. P. Lounsbury, C. E. Tod, and C. J. Levey is given, and contains much valuable information.